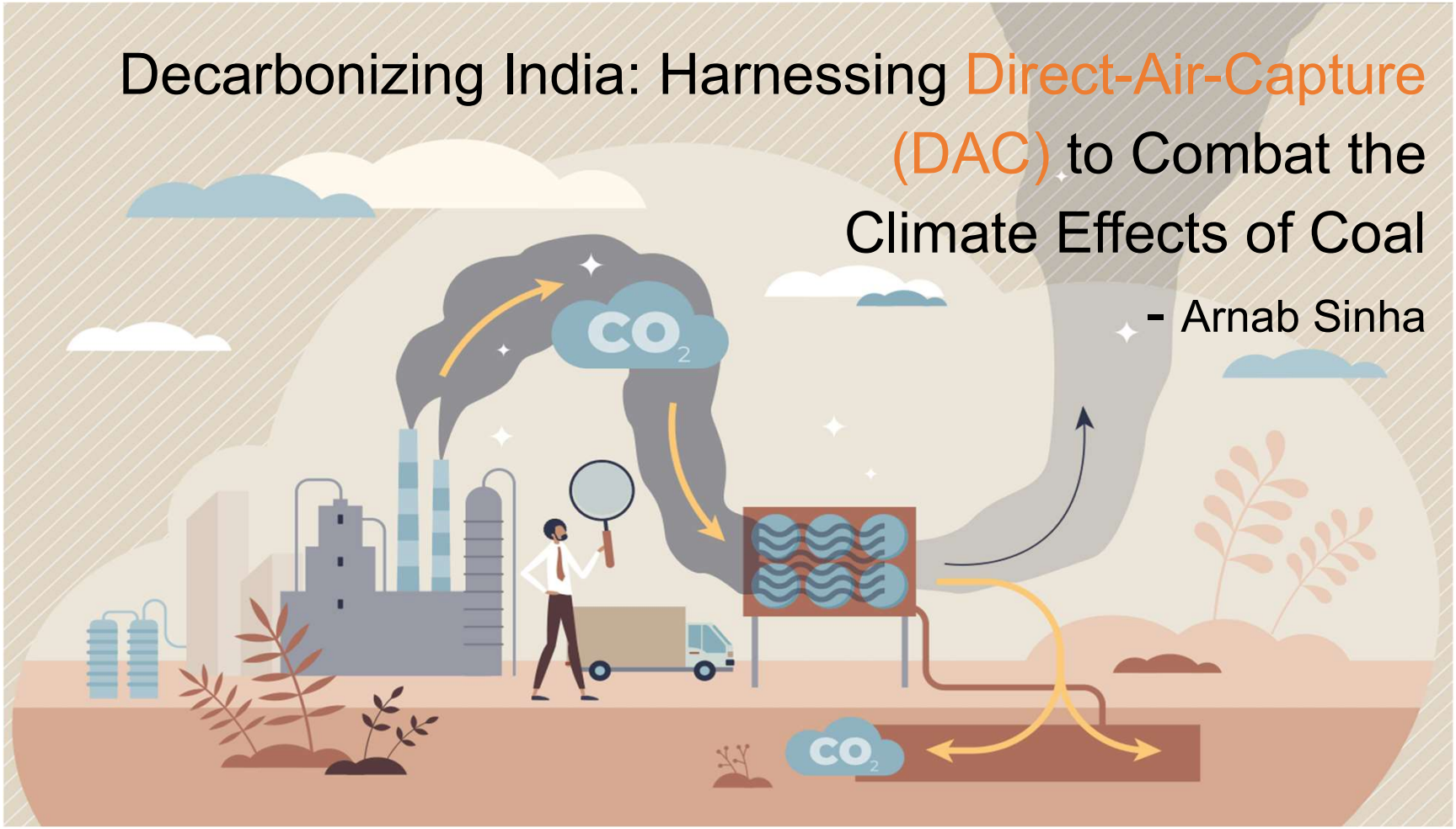
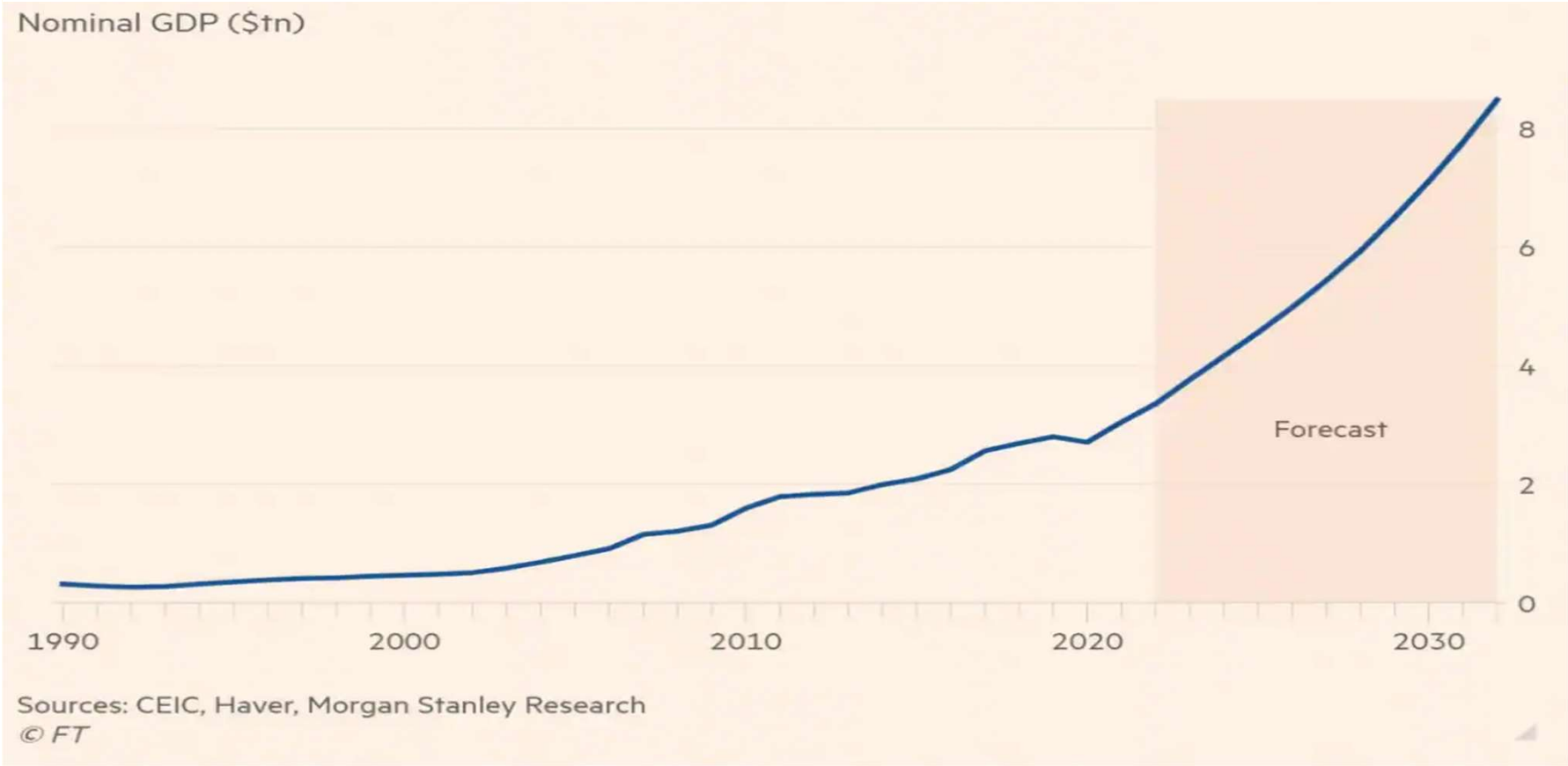
Decarbonizing India: Harnessing Direct-Air-Capture (DAC) to Combat the Climate Effects of Coal

- Arnab Sinha

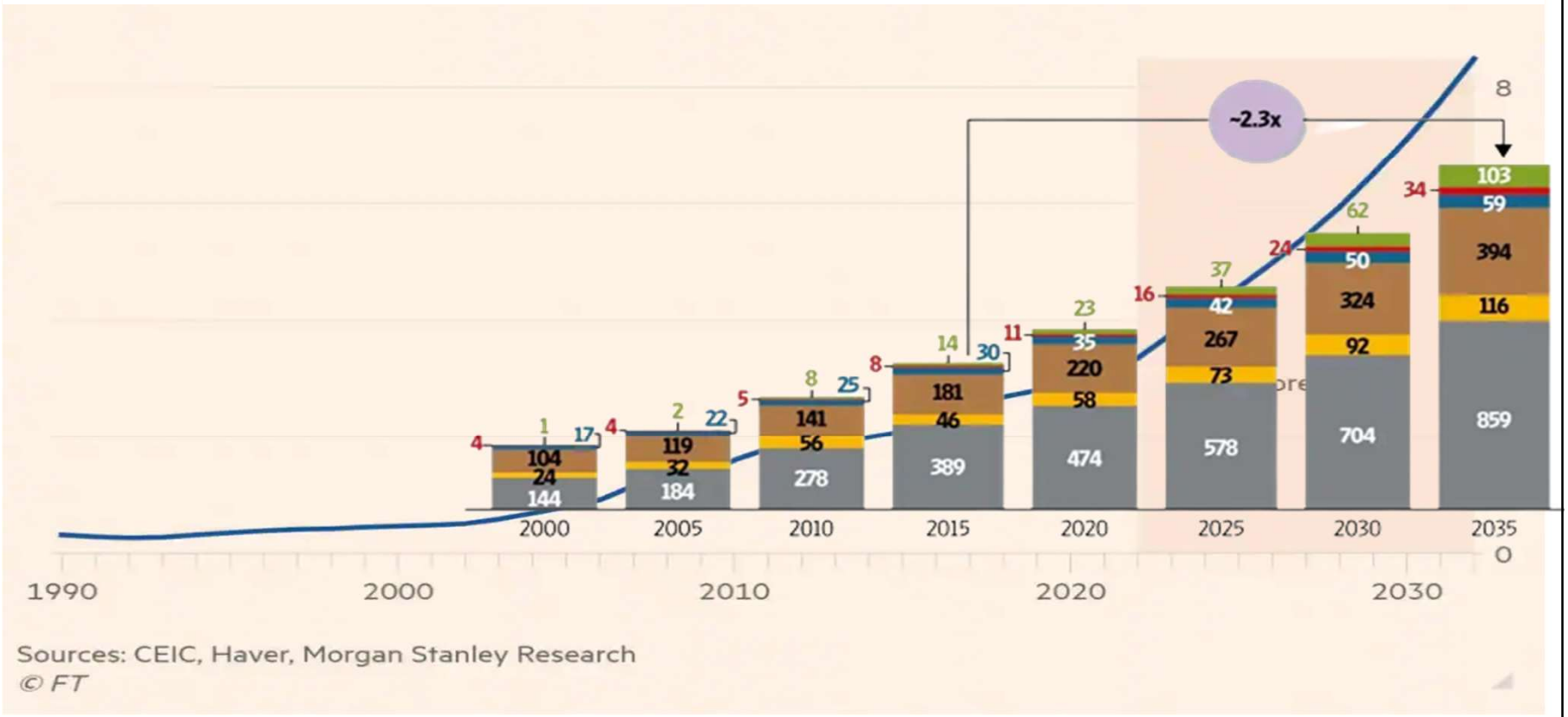


India's GDP is on the Rise!



Contribution of Coal in the India GDP

Coal has direct correlation with the Indian Economy



Sources: CEIC, Haver, Morgan Stanley Research

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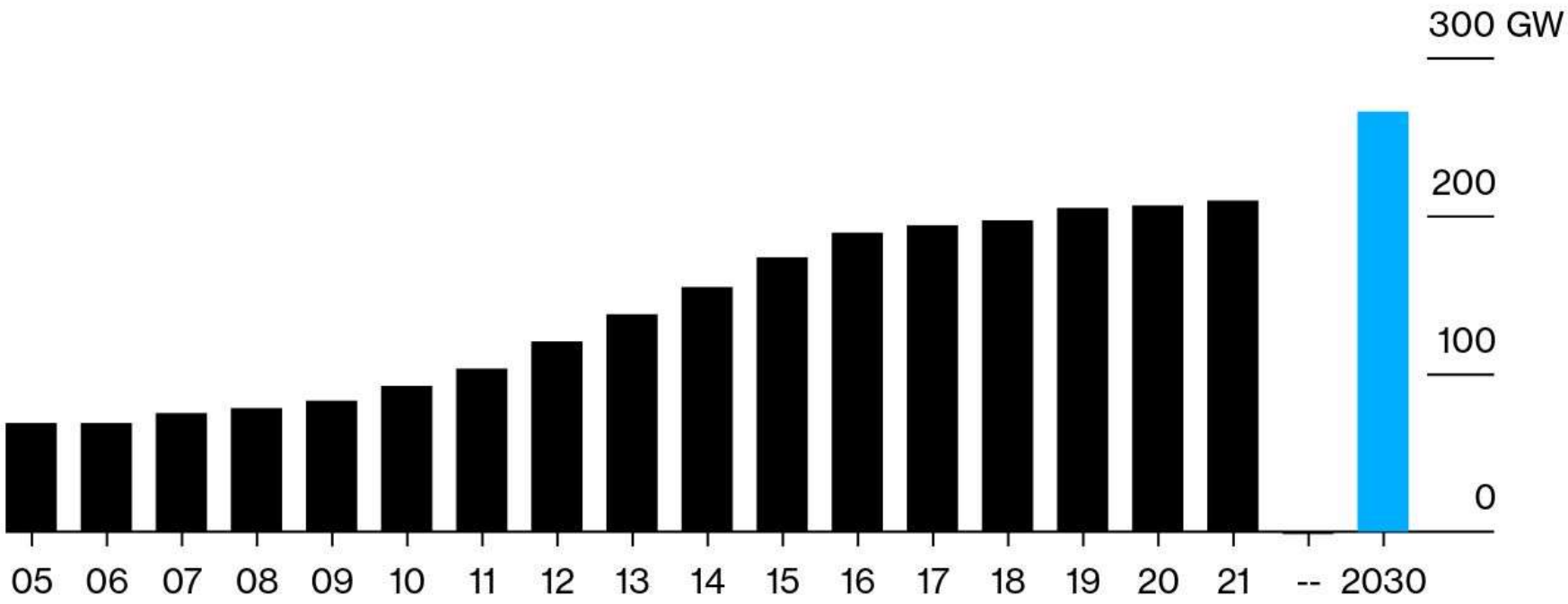
India Wants to Build More Coal Power Plants

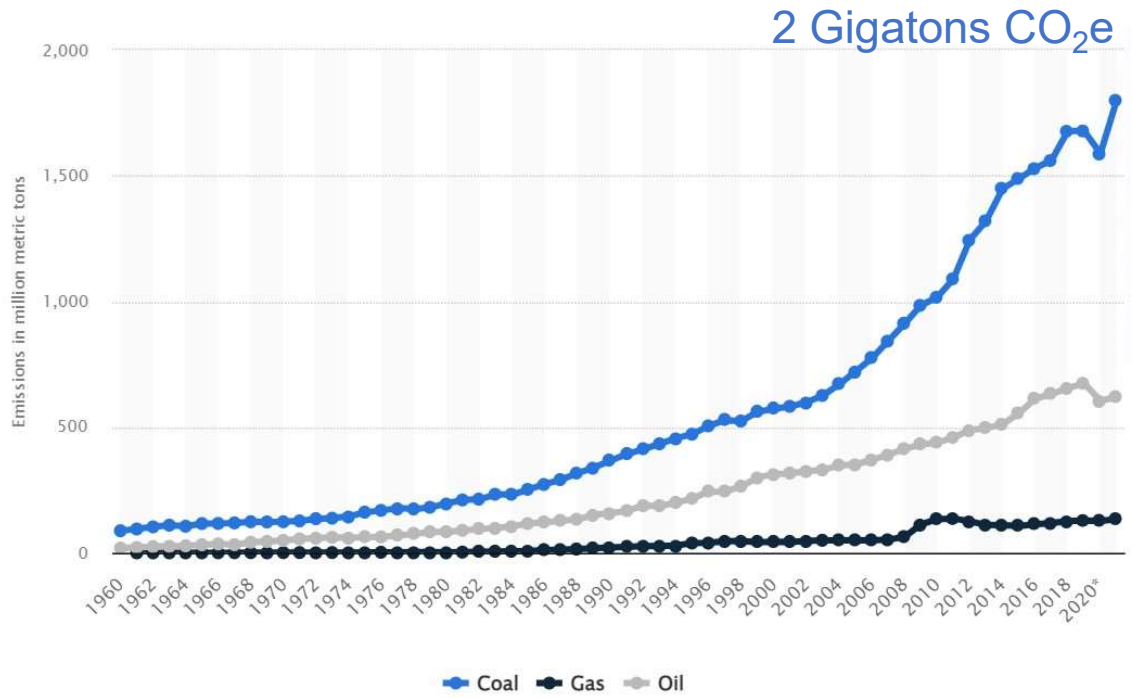
Government eyes 56 gigawatt capacity increase to meet growing demand



Source: BloombergNEF

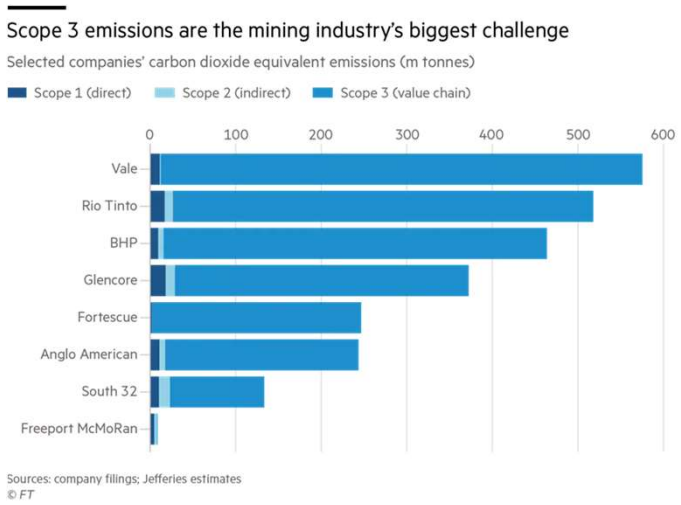
Bloomberg

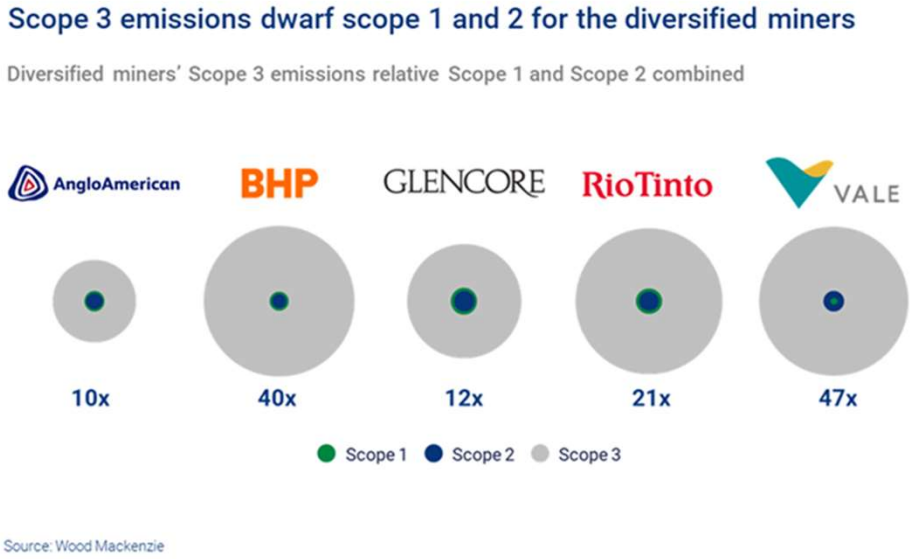
Emissions On the Rise!



Today it will take US$ 1 Trillion to remove the emitted CO_2 from the atmosphere using technology and in a *timely manner*

Mining Companies have very high *Scope-3* Emissions





Scope-3 are value chain emissions & most difficult to get rid of

The Coal Conundrum in India

NET ZERO 2070

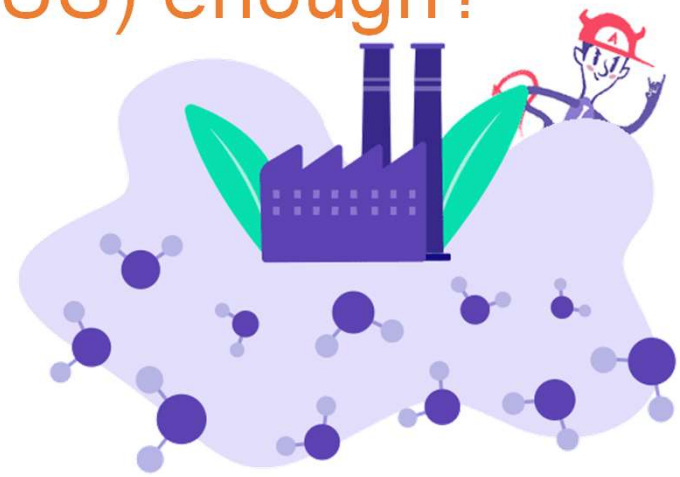
Coal Based Energy

We have to attain Net-Zero while continuing to use coal!

We have to make it possible

Is Point Source Capture, Carbon Capture Utilization and Storage (CCUS) enough?

- CCUS in India is nowhere close to implementation
- We are still in the process of framing a policy. Basically we are still thinking



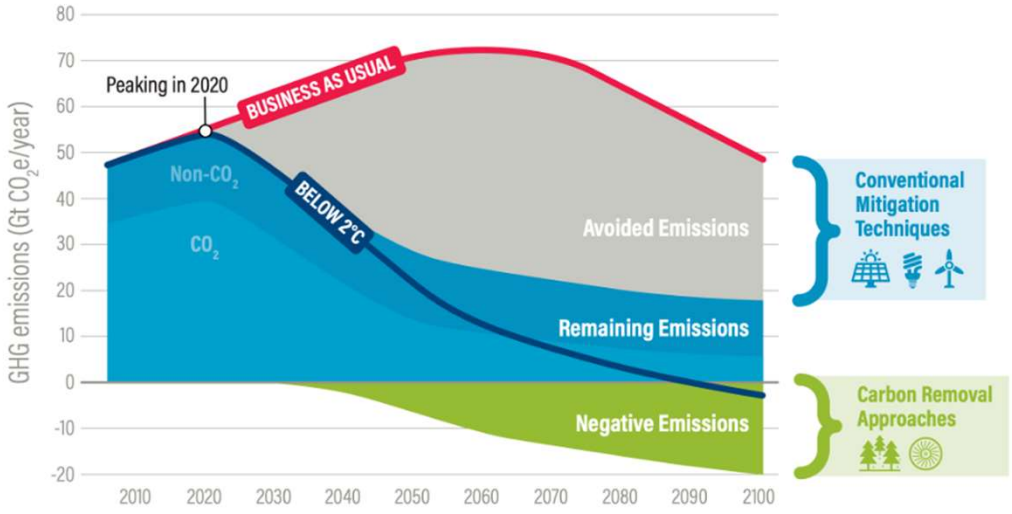
We need 30-50 years for CCUS to be a part of every emitting facility.

Even when we do, emissions cannot be made *Zero*!

That is why, we need negative emissions

We need to remove CO_2 directly from the atmosphere.

The Famous Net-Zero Curve!



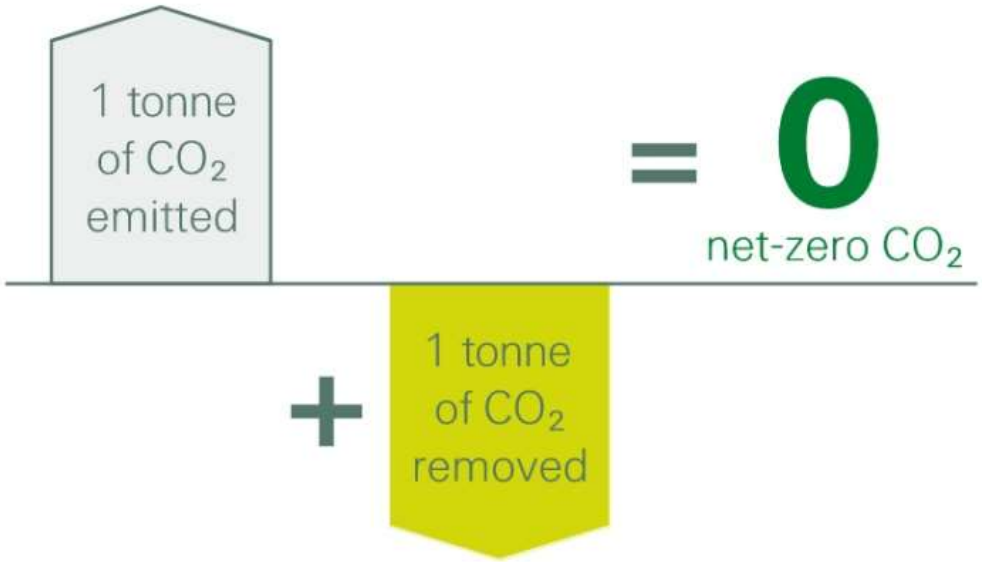
- We cannot have a state of Zero Emissions
- Legacy Emissions –We have been emitting for centuries & we are emitting as I am doing this presentation – the CO2 is already in the atm.
- Hard to abate emissions – Cement & Aviation

Even if hypothetically we stop emitting, the world will still continue to warm up.

We need negative emissions to reach Net-Zero!

What is Net Zero?

A *dynamic State* where whatever we emit, *we remove*



How do we do that?

You can say we are planting trees.
Can trees lead us to net zero?

Alone, No. Jointly, Yes.

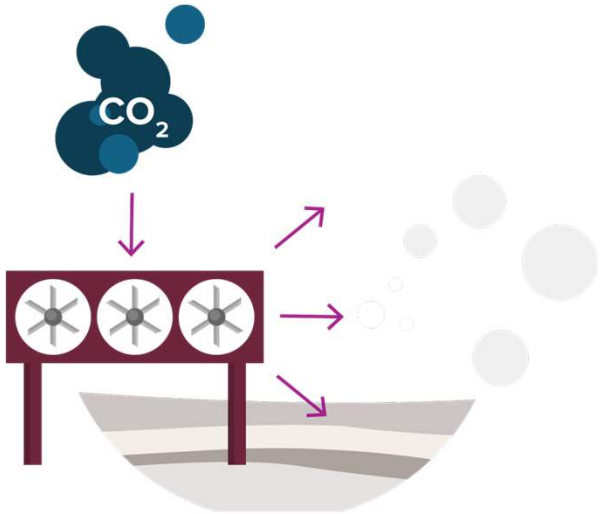
- Cannot be scaled indefinitely; huge land & water footprint; affects arable land & hence food production;
- Slow; takes 10 yrs. minimum
- Not Completely Measurable & Certifiable
- No guarantee of permanence

To remove 1 gigaton of CO_2, land area twice the size of the state of California in the US is required

How do we do it then?

The solution: Direct-Air-Capture (DAC)

Direct Air Capture is the process of *removing* carbon dioxide from the atmosphere using technology and putting it away for thousands or if possible, millions of years.



Direct-Air-Capture (DAC) is independent of the emissions source

Faster | Minimal Land and water footprint | Measurable | Permanent

Unavoidable Target

International Energy Agency

The International Energy Agency's Net Zero Scenario predicts that a colossal 980 million tonnes of DAC (Almost 1 Billion) will be required to repair our climate within the next 30 years.

The only commercial plant is doing only 4000t/annum

IPCC Says we have to remove 1 Trillion Tonnes of CO_2 from the Atmosphere via various methods including DAC

Direct-Air-Capture Companies in the West

Only Climeworks (Switzerland) is commercial

Carbon Engineering (Canada) recently got sold for US$ 1.1 Billion to Occidental Petroleum

Global Thermostat (USA) Piloting

Few other companies are underway

Some Existing Direct-Air-Capture (DAC) Facilities

Carbon Engineering

CLIMEWORKS

global thermostat
a carbon negative solution

DAC Technology Adoption

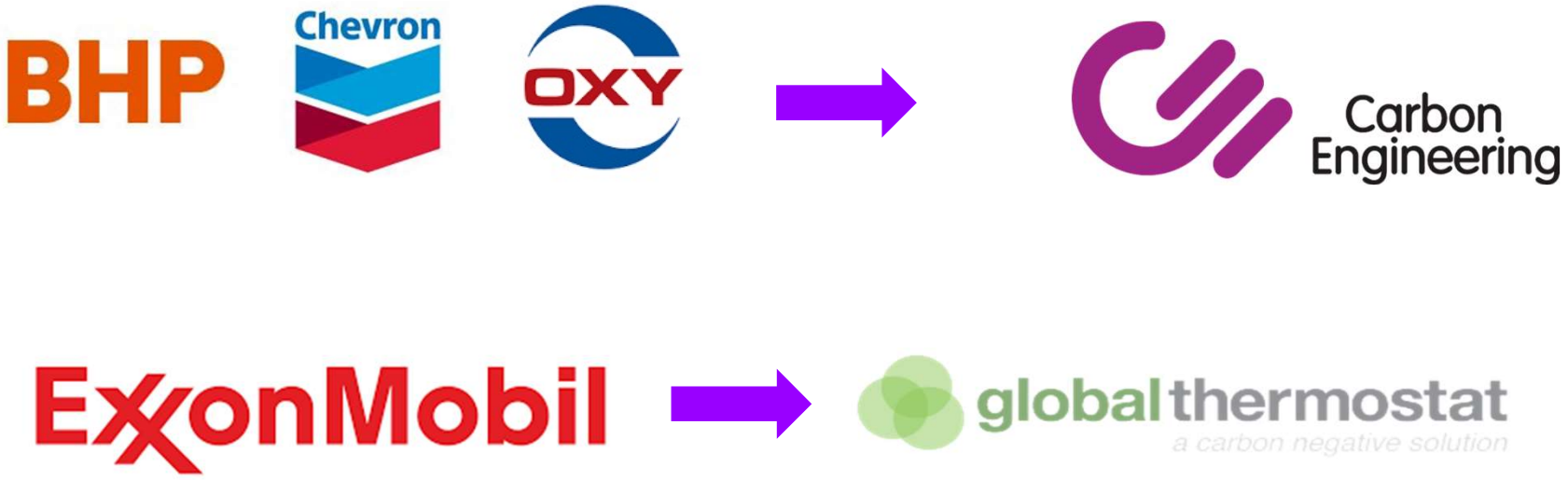
The following brands have adopted DAC for removing their emissions, despite the exorbitant cost.

Big Tech Supports DAC[1]

US$ 925 Million

1. We've Never Seen a Carbon-Removal Plan Like This Before, The Atlantic: https://www.theatlantic.com/science/archive/2022/04/big-tech-investment-carbon-removal/629545/

Oil, Gas & Mining Majors Support DAC



Bill Gates is supporting and Investing in Direct-Air-Capture (DAC)

Source: Carbon Engineering & Global Thermostat website

Latest Developments in the DAC Space

Carbon Engineering

Last month Carbon Engineering, a Canada Based DAC company was acquired for US$ 1.1 Billion by an US Oil & Gas Major.

amazon.com

Committed to purchase 250,000 metric tons of carbon removal & invested in Carbon Capture Inc. a US based DAC Company

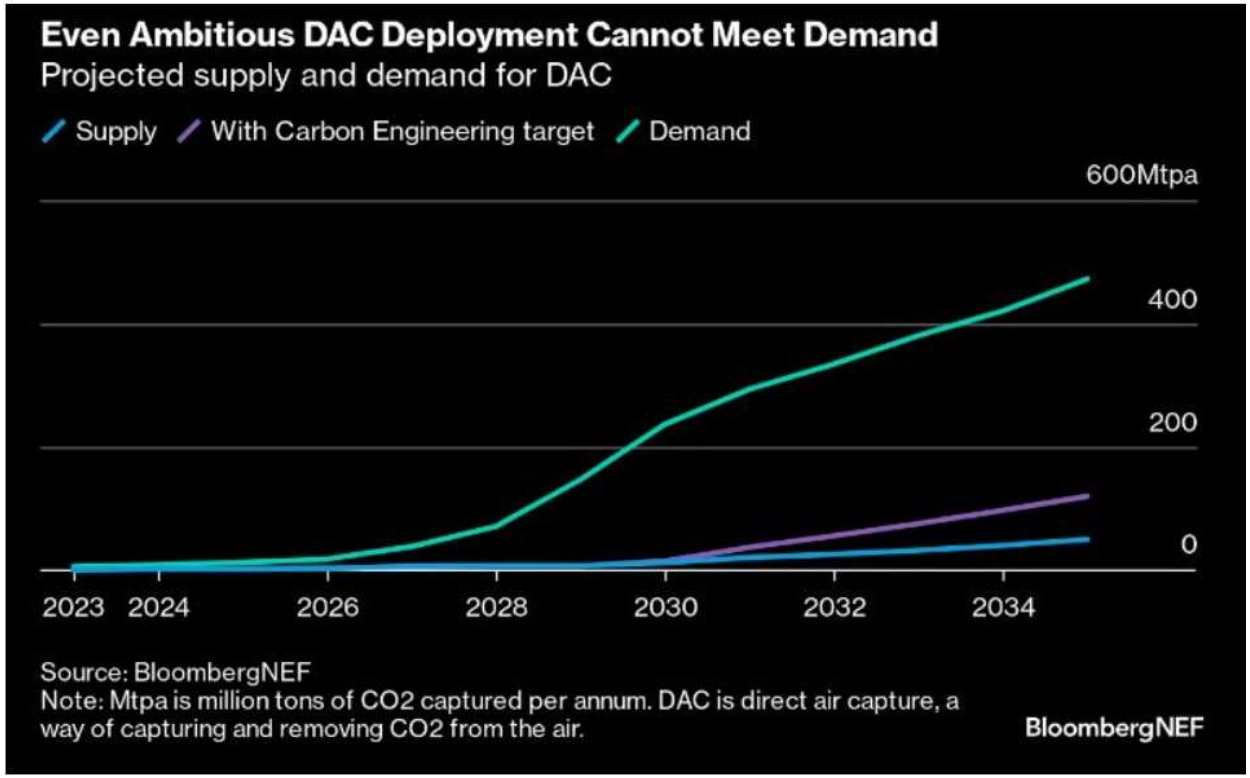
UNITED STATES OF AMERICA

US Government announces US $1.2 Billion For Nation's First Direct Air Capture Demonstrations

Challenges with Direct-Air-Capture?

- Costly, as the concentration of CO2 in the atmospheric air is very thin (0.04%), it requires process minimum 1.34 x 10^{15} m^3 of air to capture 1 Gigaton of CO2 from the atmosphere (Currently it is US$ 600-1000/tonne of CO2 removed)
- Energy intensive for the same reason.
- What makes it more of a challenge – it is unavoidable!

Huge Supply Demand Gap – Prices will Rise



India & Direct-Air-Capture (DAC)

Keping in mind current and future Coal usage in India and the emissions, India needs such facilities more than countries who are doing it.

If we delay, there is no doubt that tomorrow, succumbing to international pressure, Indian emitting companies will have to pay trillions of dollars to foreign Direct-Air-Capture (DAC) companies for removing their emissions – trillions of dollars will flow out of our country leading us to a possible economic crisis. – We have to stop this.

Our objective is to make India *Aatmanirbhar*

आत्मनिर्भर भारत

First DAC Company in India

that is why we have created the first DAC company in India for India to remove its own emissions

Novonanmek

Novonanmek the first & only Direct-Air-Capture (DAC) company in India.

Recognition

DST@ 1971-2021 विज्ञान एवं प्रौद्योगिकी विभाग DEPARTMENT OF SCIENCE & TECHNOLOGY

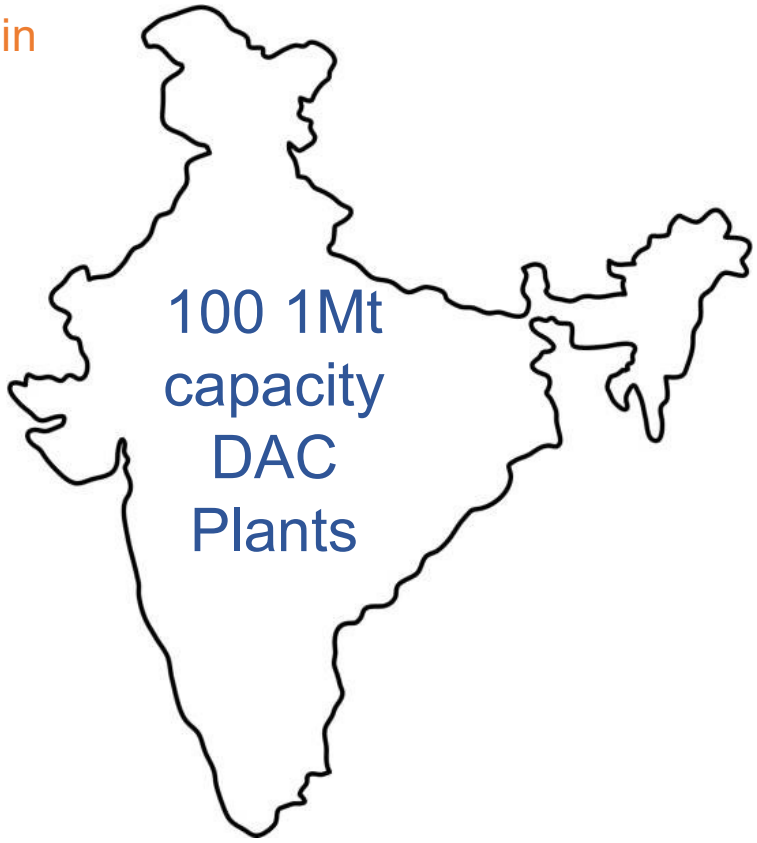
UKRI UK Research and Innovation

Novonanmek | Innovative Carbon Capture technology in India.

The Movement Called “Novonanmek”

Our Mission: 100 1Mt Capacity DAC Facilities in this Century

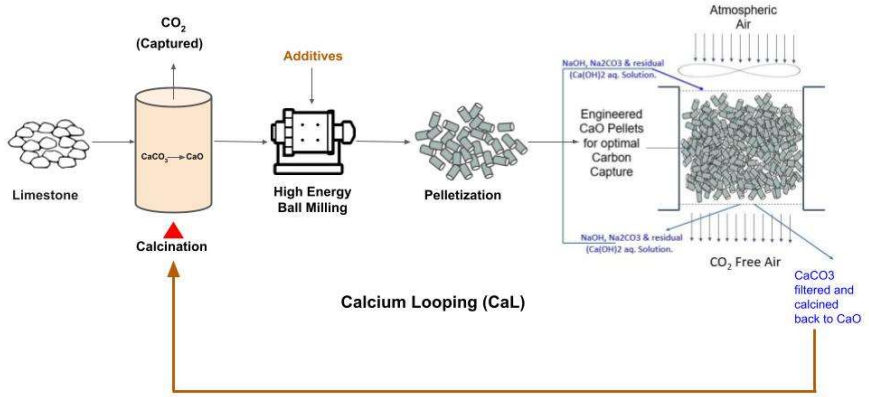
With our technology we want to *lay the foundation* for 100 Nos. 1Mt removal capacity Direct-Air-Capture (DAC) plants in India in this century



Our Technology

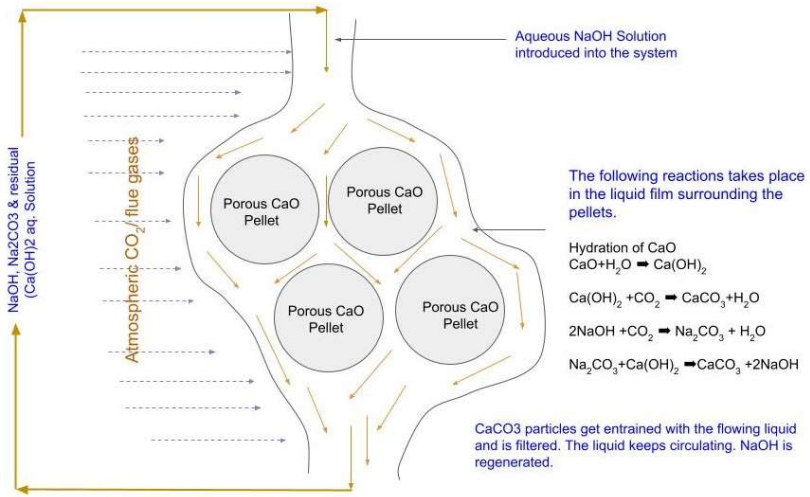
Based on Calcium Looping (CaL)

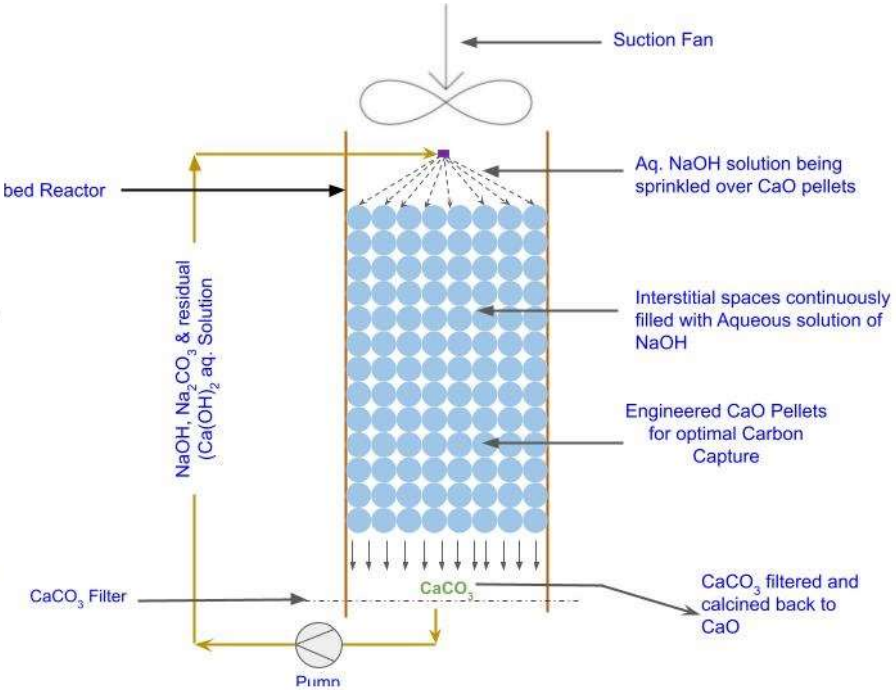
1. Carbonation Reaction: $CaO + CO_2 \rightarrow CaCO_3$
2. Calcination Reaction: $CaCO_3 \rightarrow CaO + CO_2$



- Simplified
- Scalable &
- Sustainable Technology

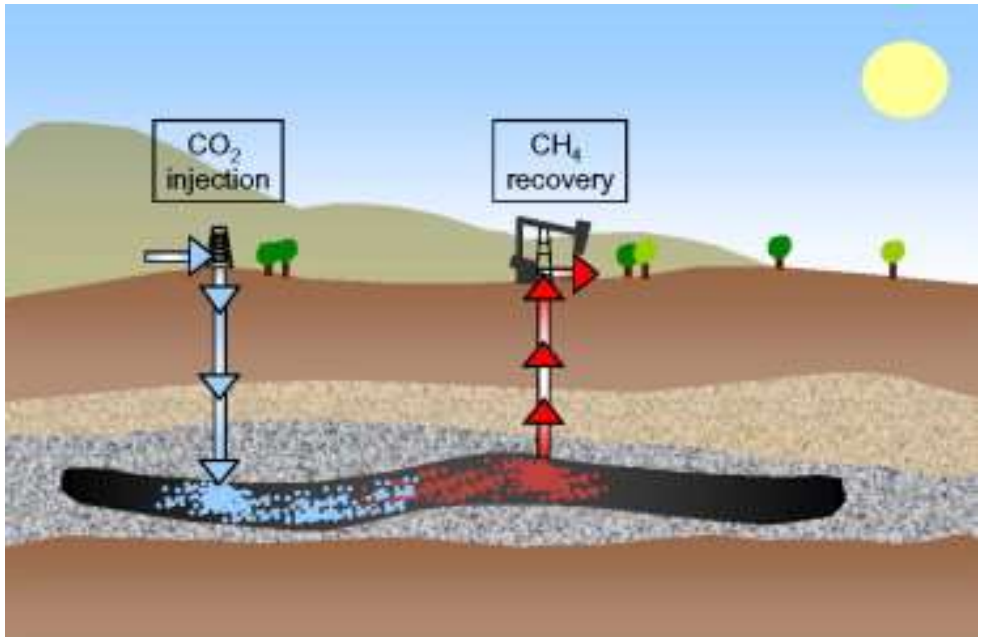
Our Technology Continued…





Captured CO_2 is sequestered Underground

One of the good ways to utilize and sequester CO_2 is in
Enhanced Coal Bed Methane Recovery (ECBMR)



"Captured CO_2 is used to displace the adsorbed methane molecules and increase methane production"

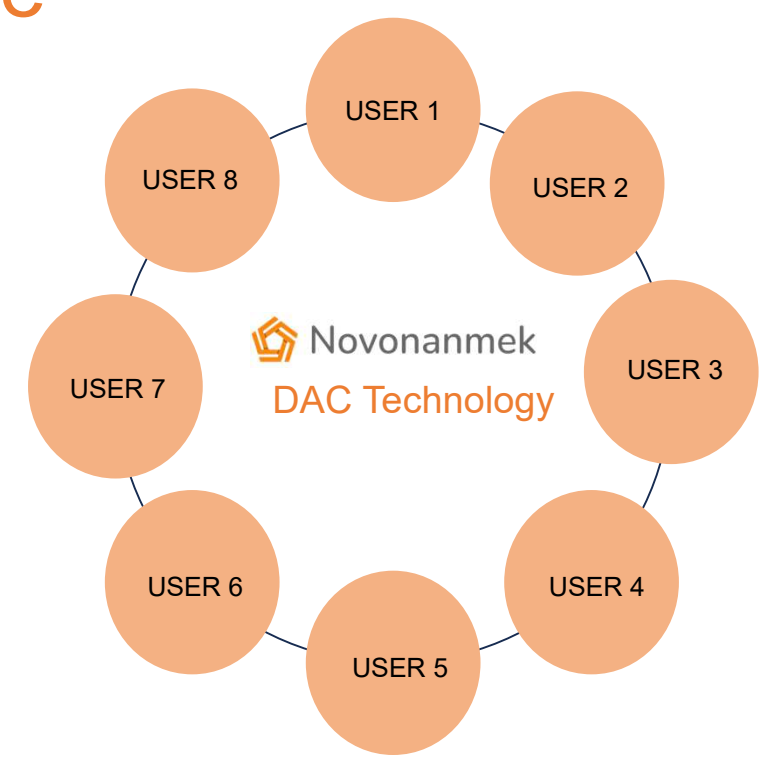
- Both DAC and ECBMR technologies are in their early stages
- Both technologies should collaborate! – For Capture and Utilization/Sequestration

Join the Movement
This cannot be done alone

Need to come together &

Collaborate

We are willing to share* our technology and build DAC facilities together with emitting companies so that they can remove their own emissions & be self sufficient.



*terms & conditions apply

Let us come together to Prosper, attain Net-Zero and make India *Aatmanirbhar*

Thank You!